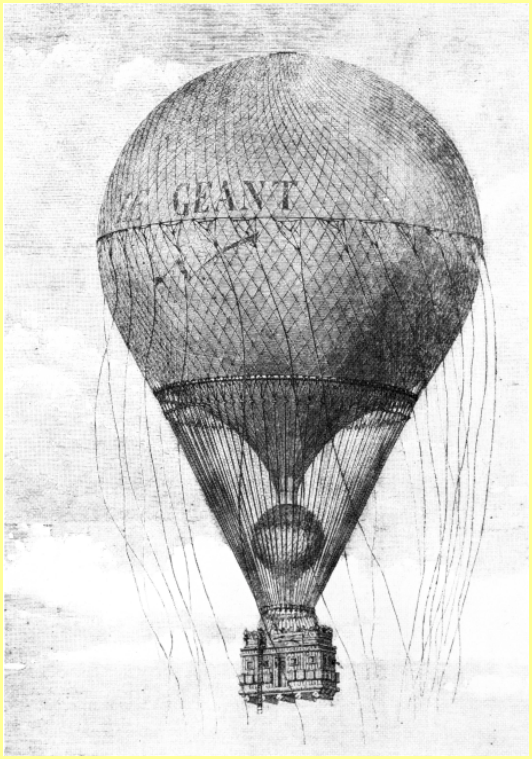
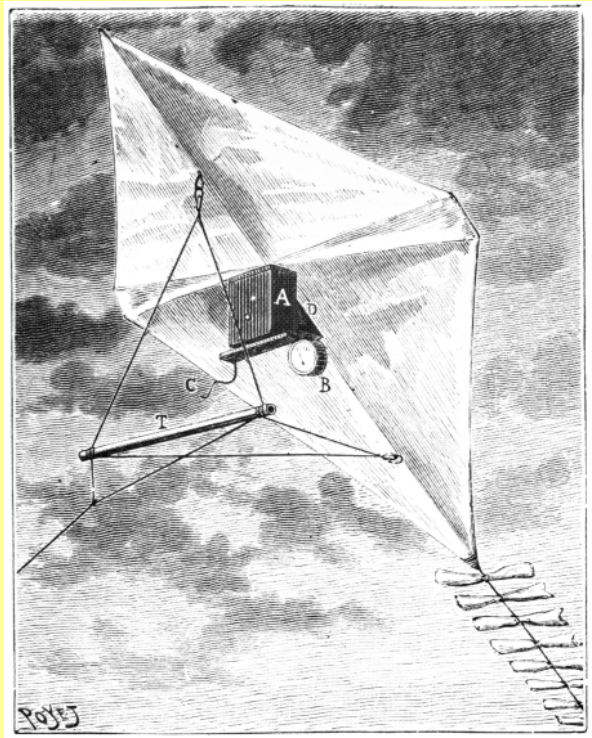
LDCM Workshop

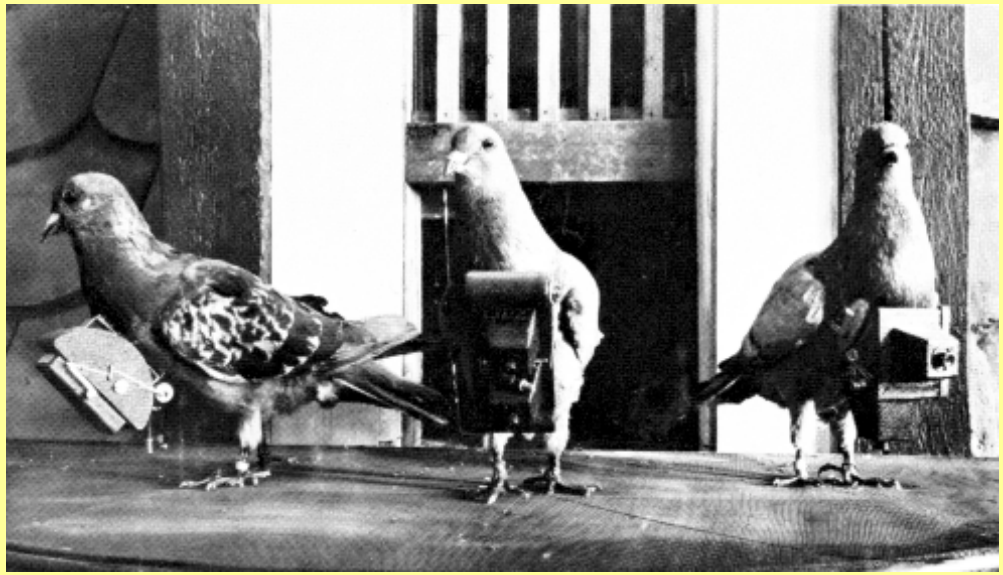
Tom Lillesand

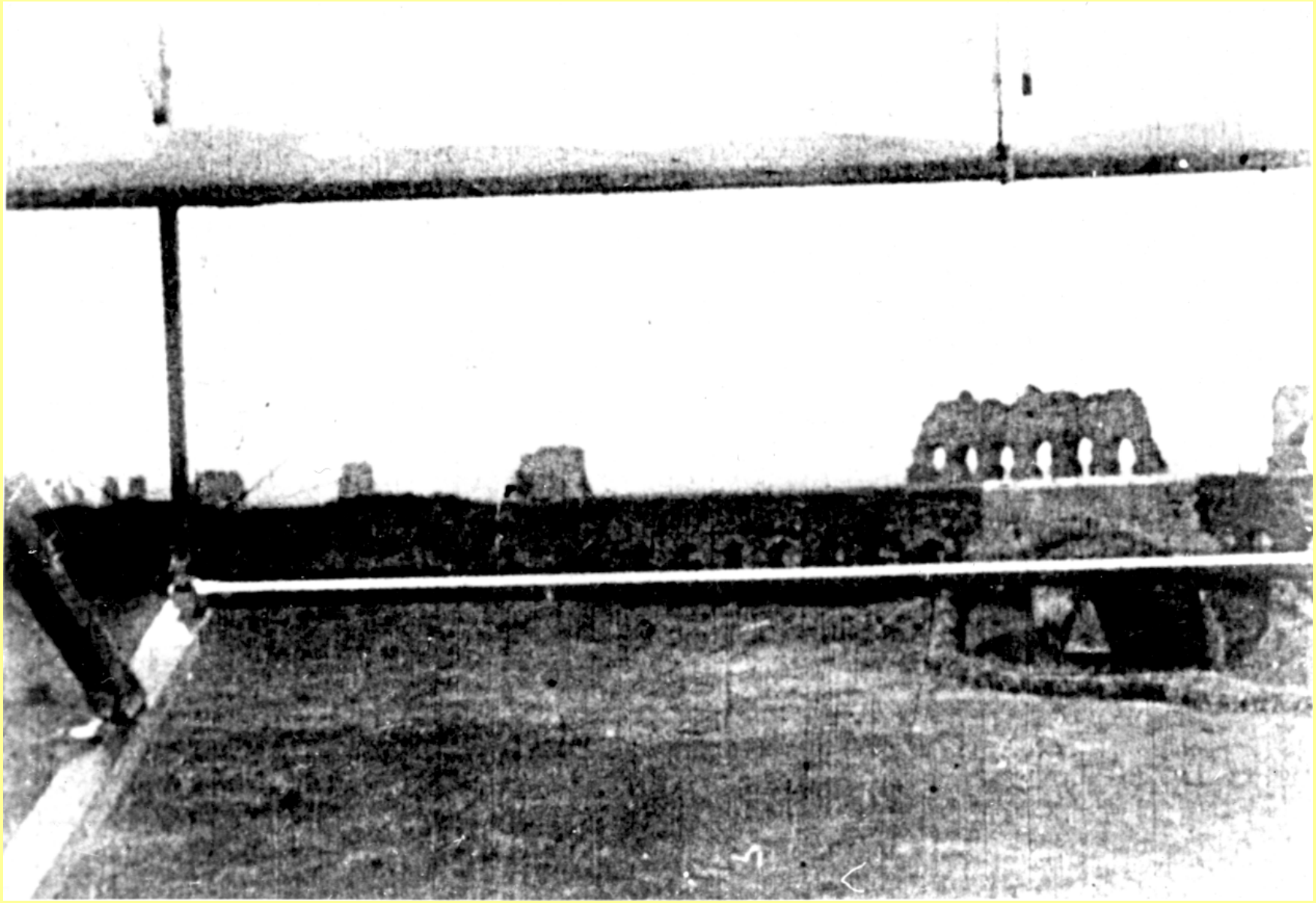
January 10, 2001



Pre-Landsat
Data
Sources
Used in
Wisconsin !!!







Pre-Landsat Data Sources (Cont.)

Representative Landsat TM and ETM+ Applications in Wisconsin

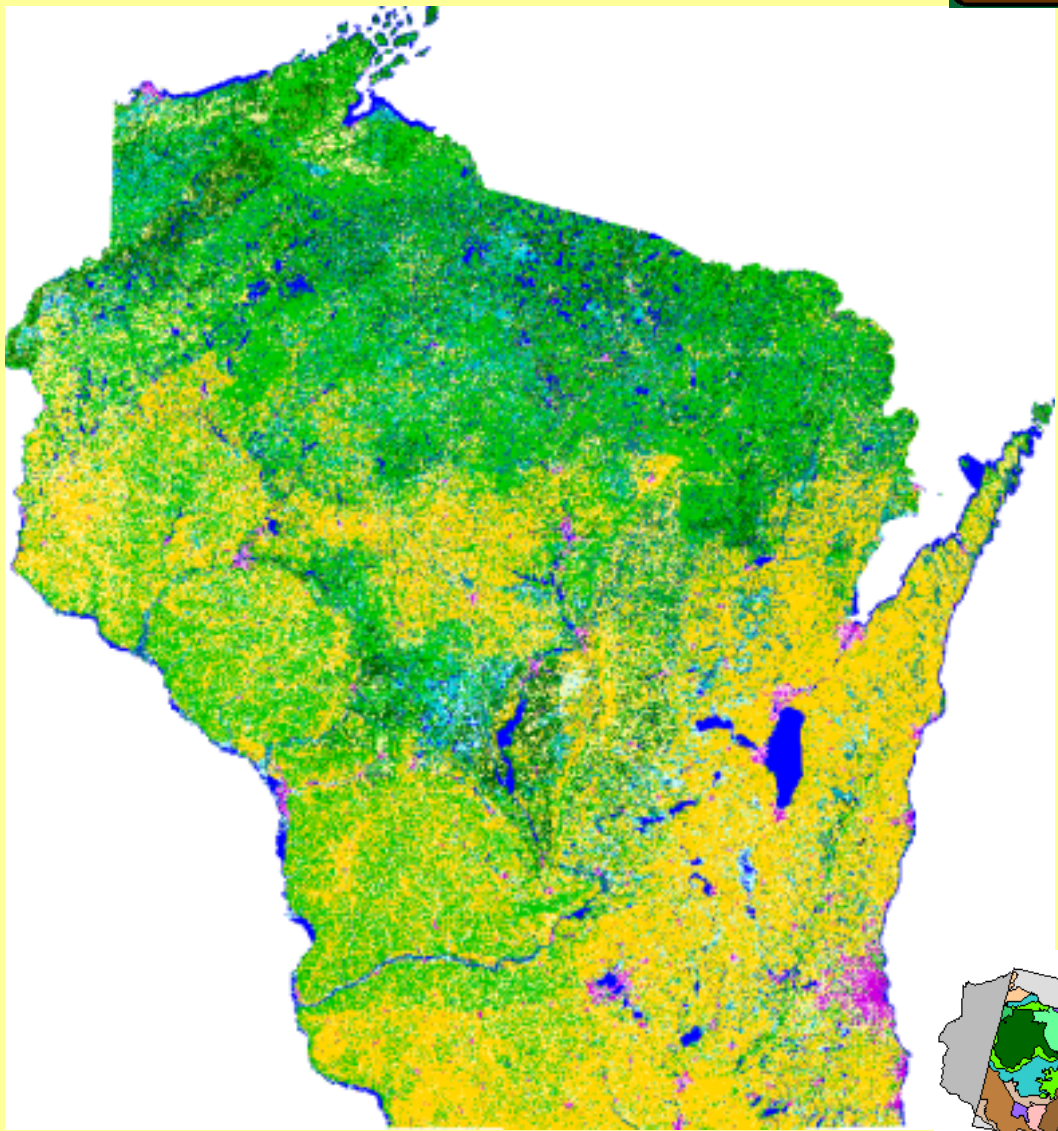
- Hydrologic Modeling
- Statewide Land Cover Mapping (WISCLAND)
- Meso-scale Crop Assessment
- Habitat Restoration
- Timber Blow-down Assessment
- Lake Water Clarity Monitoring
- Mapping Surficial Geology
- “Resource Smart” Sub-division Planning
- Siting a Truck Weigh-in-Motion Facility
- Monitoring Reed Canary Grass as an Indicator of Wetland Quality
- Forest Inventory
- Watershed Management
- Land Restoration Planning and Monitoring
- .....many others

Environmental Remote Sensing Center

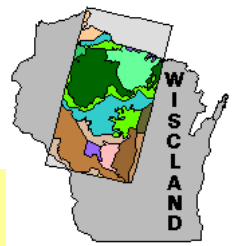
WISCLAND: Statewide Land Cover Data

Wisconsin Department of Natural Resources

- A Partnership of public and private organizations, coordinated by the Wisconsin State Cartographer's Office.
- Research based at ERSC and production at the Wisconsin DNR.
- A component of the tri-state Upper Midwest Gap Analysis Project.
- Based on Landsat TM imagery from ca. 1992, plus ancillary information from GIS databases and extensive field investigations.



National Gap Analysis Project



WISCLAND PARTNERS

State Agencies **–**

- Dept. of Natural Resources
- Dept. of Transportation
- Dept. of Agriculture, Trade & Consumer Protection
- Wisconsin Geological & Natural History Survey

Federal Agencies **–**

- USDA – Natural Resource Conservation Service
- USDI – Nat'l Biological Service, Gap Analysis Program
- USEPA – Great Lakes National Program Office
- USDA – Forest Service, Chequamegon Nat'l Forest
- USDOI – USGS, Water Resource Division

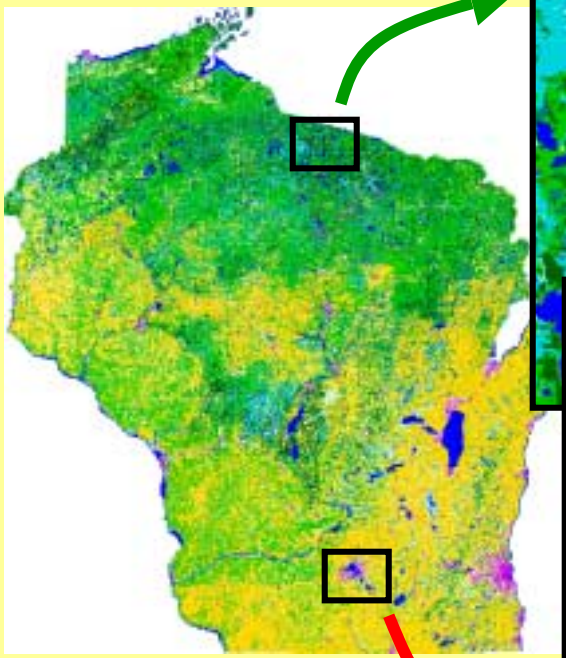
Other Partners **–**

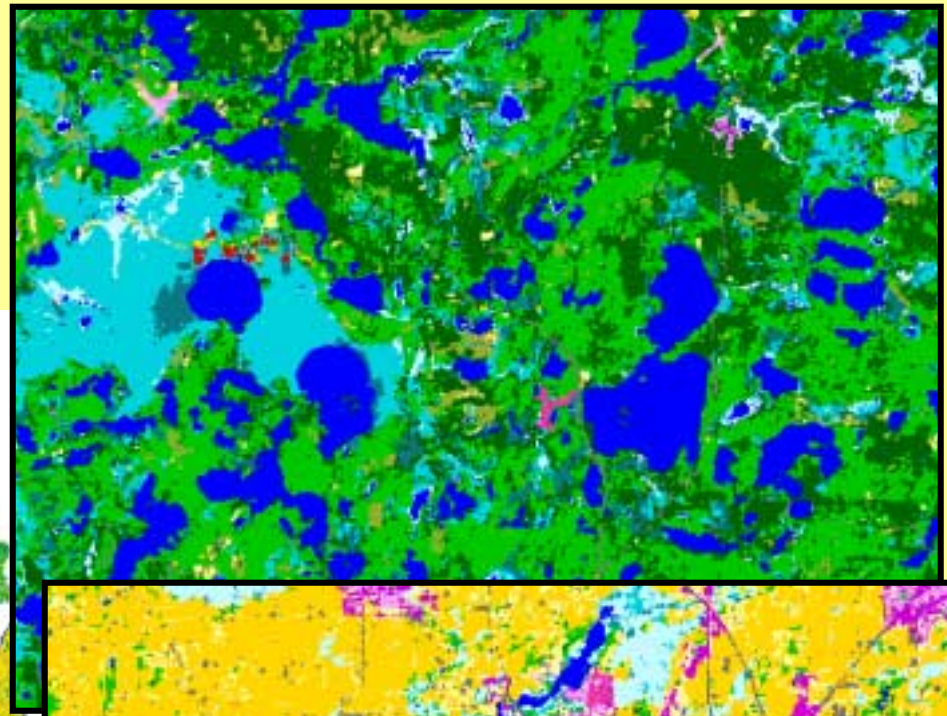
- Wisconsin Power and Light
- Wisconsin State Cartographer's Office
- Wisconsin Land Information Board
- UW-Madison, Institute for Environmental Studies

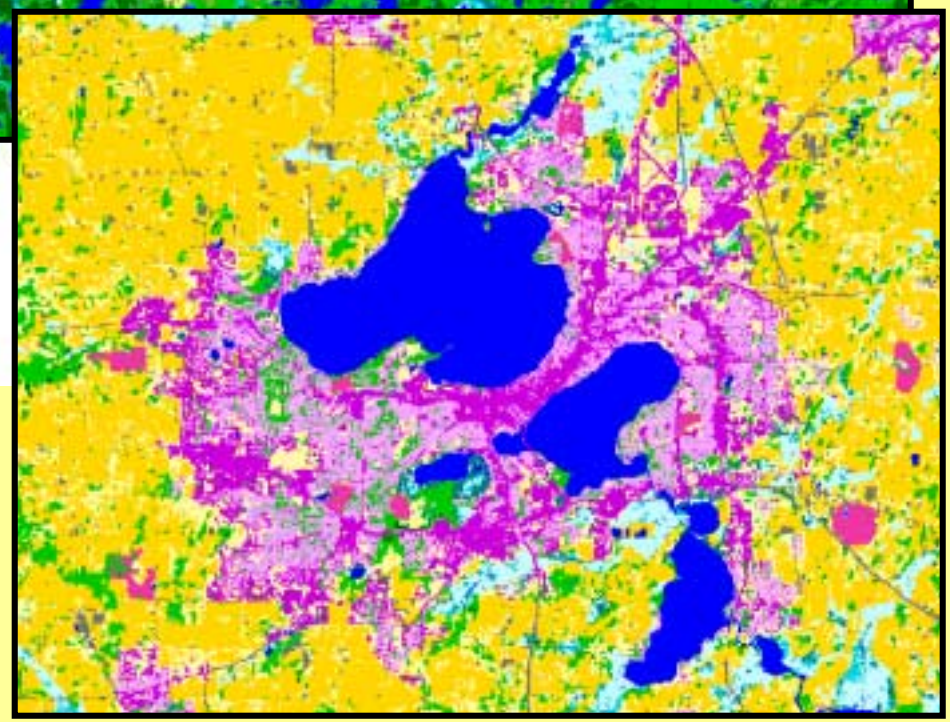
WISCLAND

Environmental Remote Sensing Center

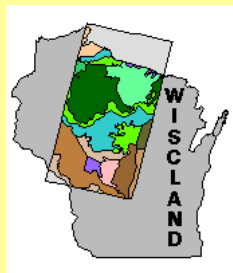
Wisconsin Department of Natural Resources





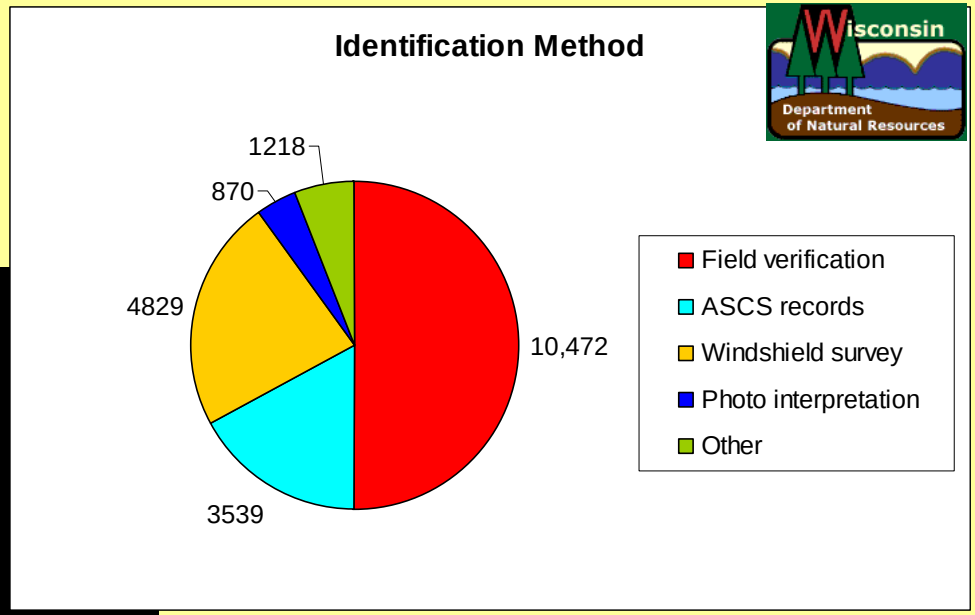


National Gap Analysis Project

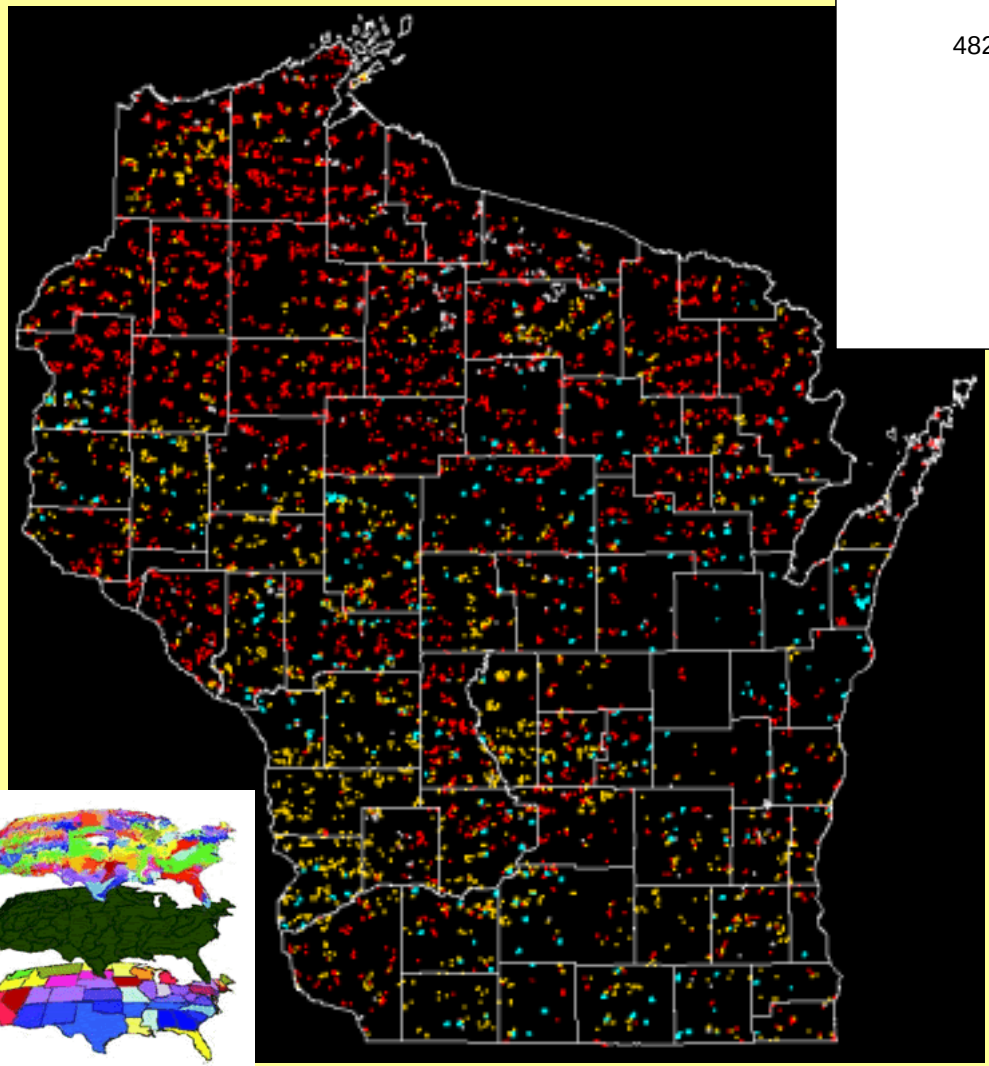


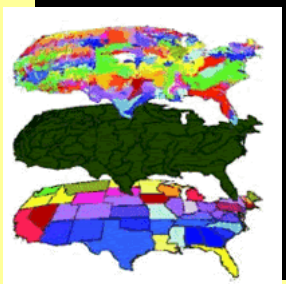
Environmental Remote Sensing Center

WISCLAND Reference Data Polygons



Wisconsin Department of Natural Resources



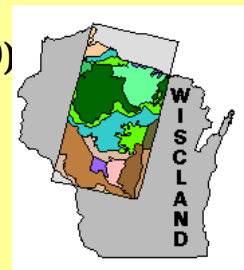


National Gap Analysis Project

Identification Method

- **Field verified (10,472)**
- **ASCS records (3,539)**
- **Windshield survey (4,829)**
- **Other (2,088)**

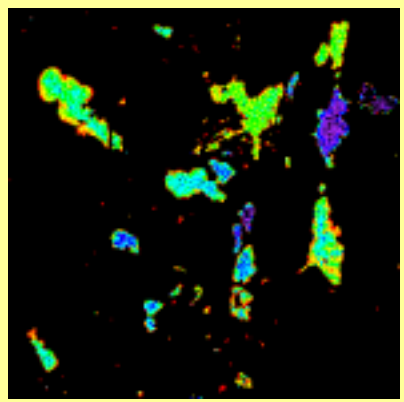
Total: 20,928 polygons



Remote Sensing of Lakes and Lake Ecosystems:

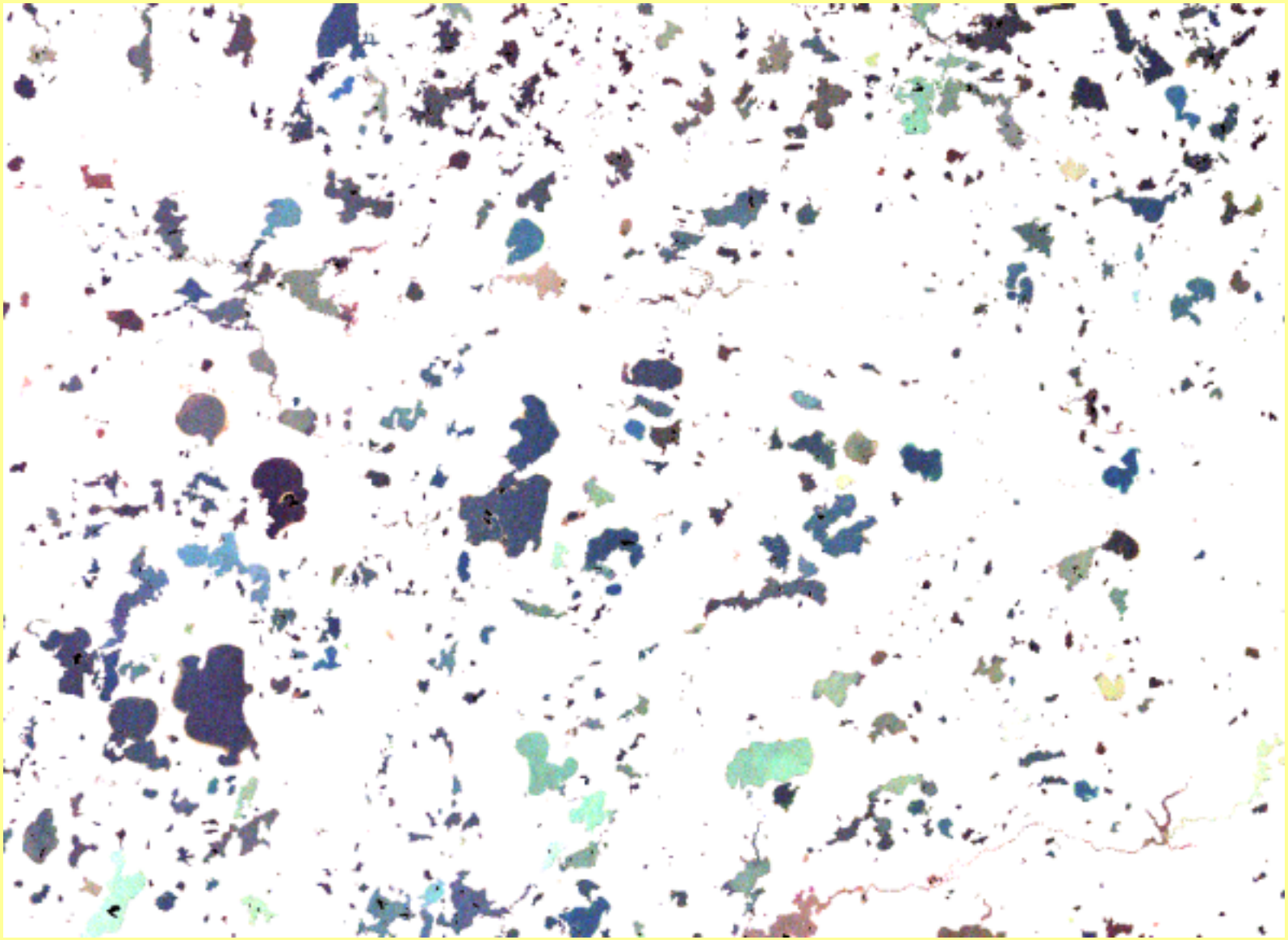
The Satellite Lake Observatory Initiative (SLOI)

- UW-Madison Environmental Remote Sensing Center
- NASA Upper Midwest Regional Earth Science Applications Center (RESAC)
- NSF North Temperate Lakes Long –Term Ecological Research (LTER) Program
- Wisconsin Department of Natural Resources
- Citizen Self-Help Monitoring Program

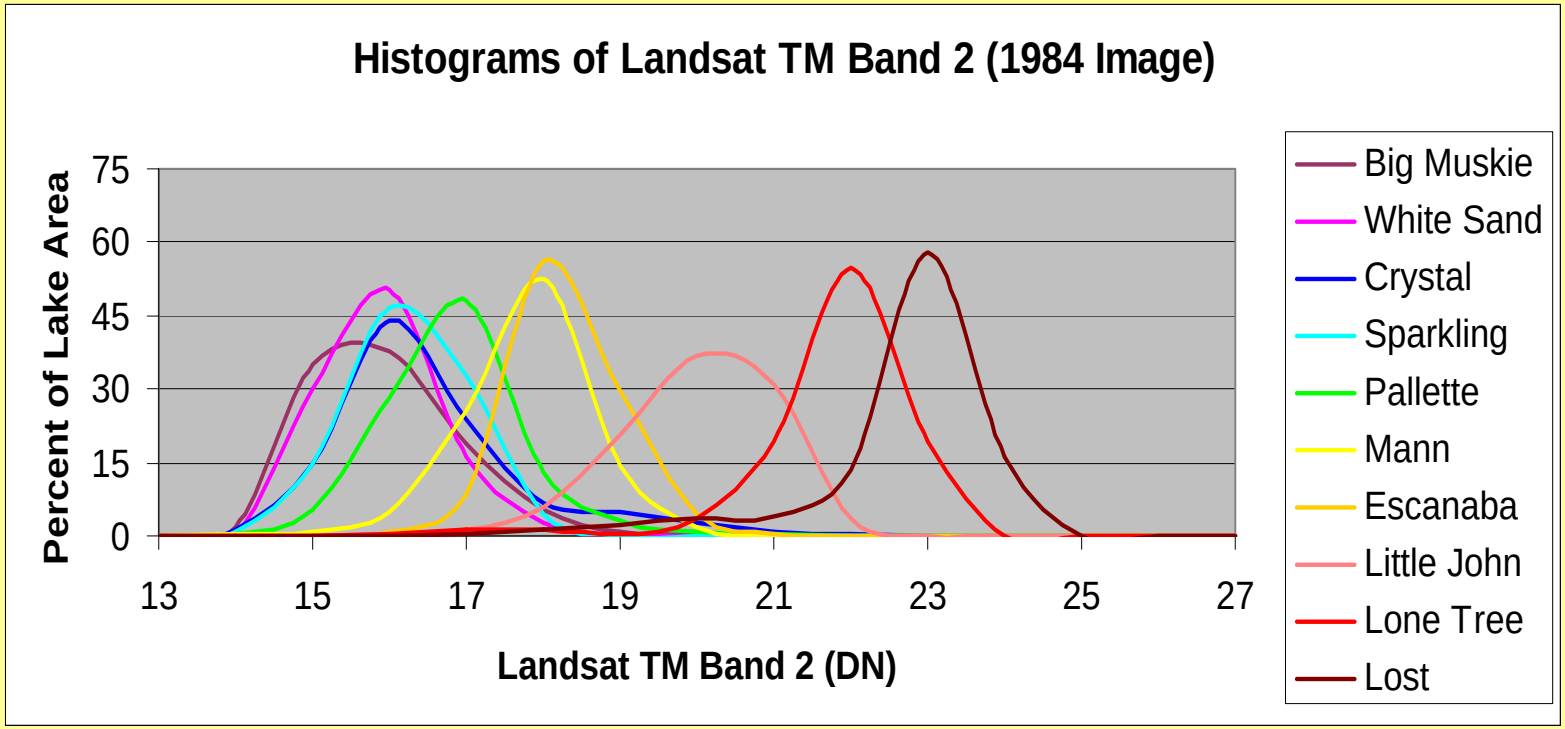


Landsat-7 ETM+ Image of the Trout Lake Region (6 October 1999)

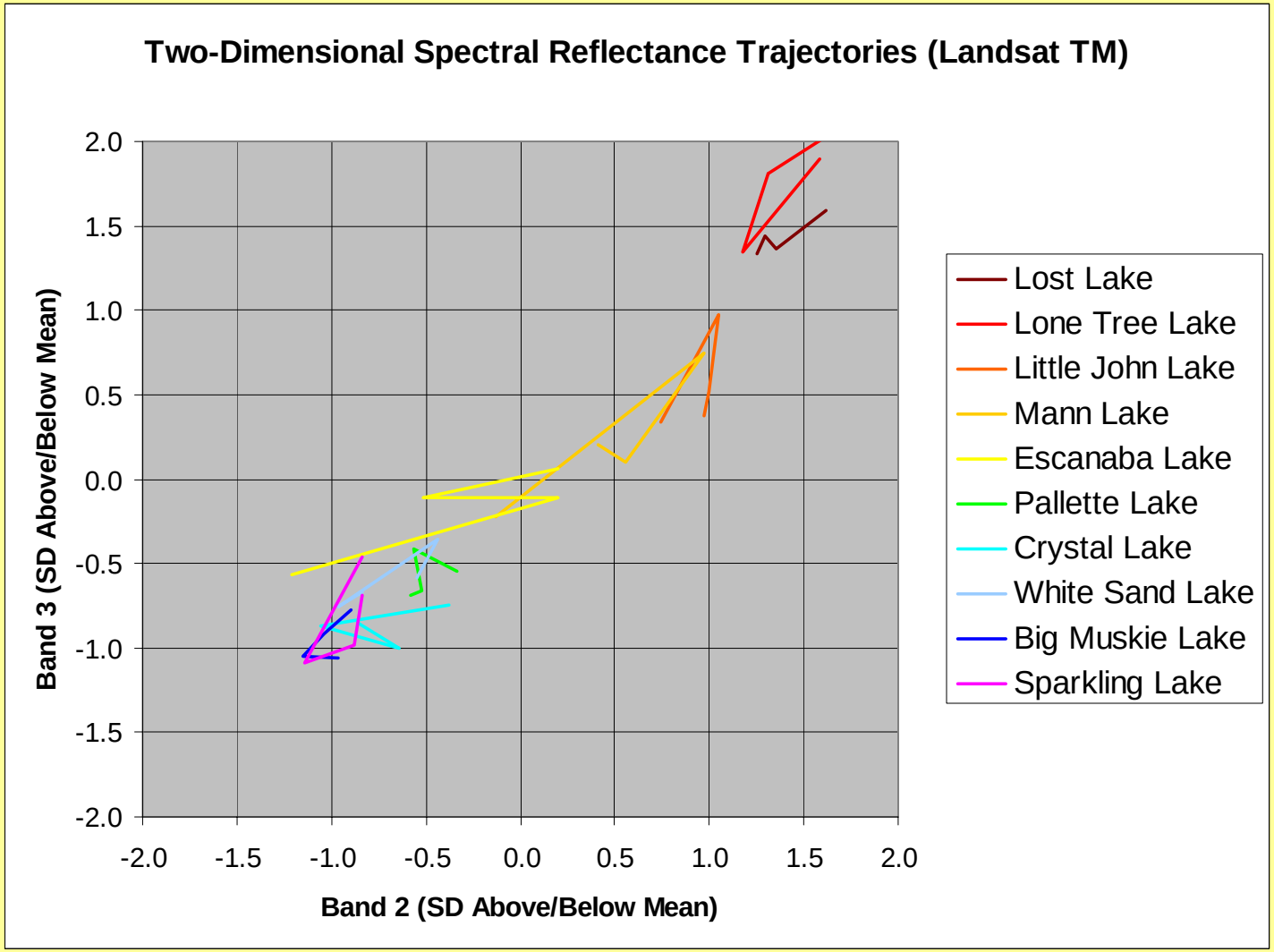
Lakes only (land masked out) - Bands 3, 2, 1 as R, G, B



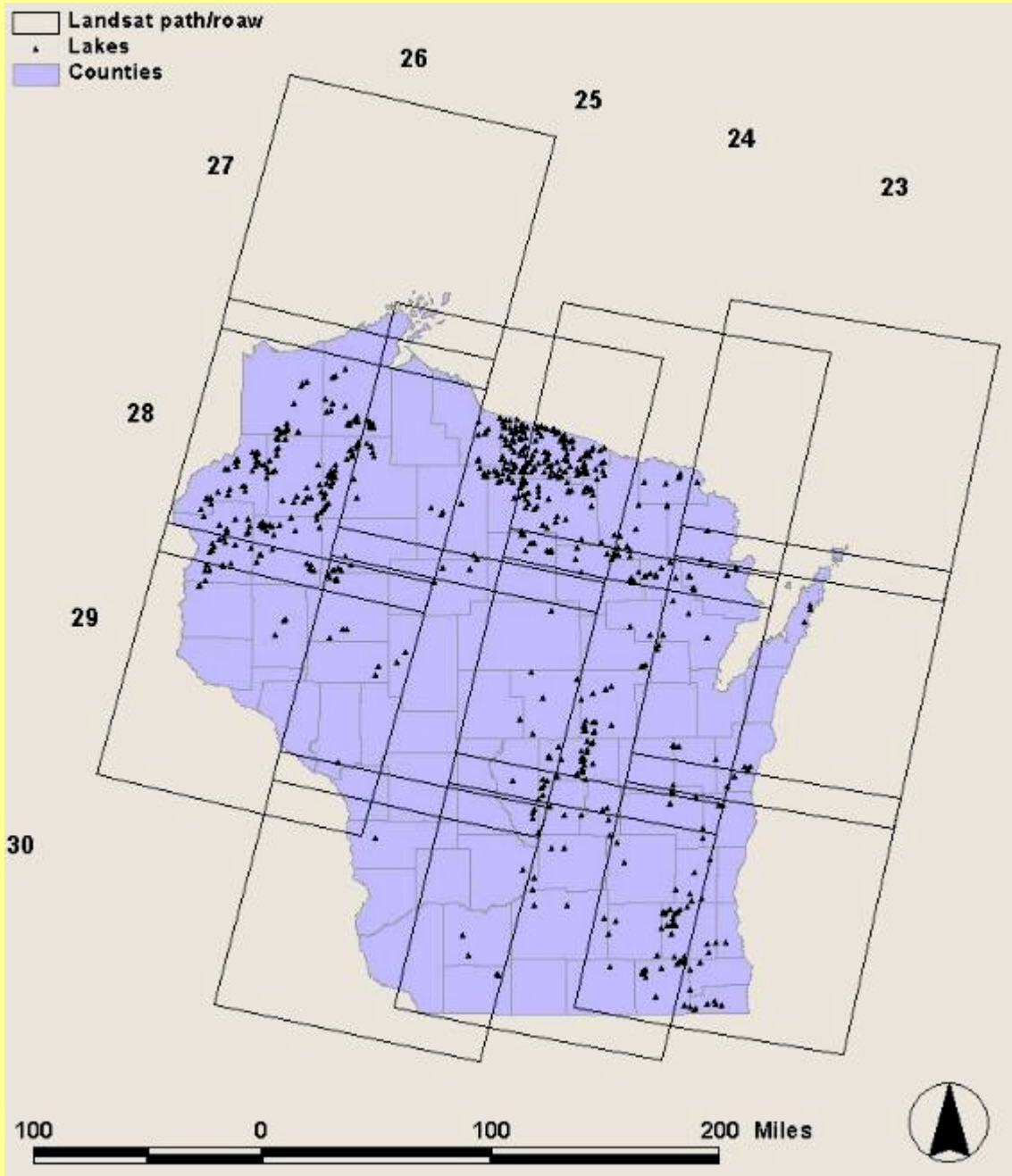
Spectral Variability of Lakes in Space



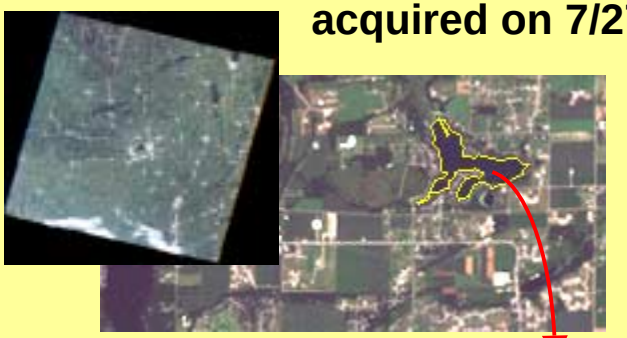
Spectral Variability of Lakes in Time



WDNR Self-Help Lake Monitoring Program



Landsat-7 satellite image acquired on 7/27/99

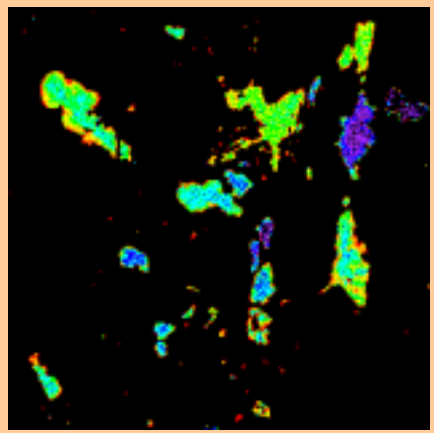


Sensor Channel	Wavelength (μm)	Spectral Region	Measured Reflectance
1	0.45-0.52	Blue	62.97
2	0.53-0.61	Green	37.85
3	0.63-0.69	Red	25.23
4	0.75-0.90	Near-infrared	19.09
5	1.55-1.75	Mid-infrared	10.17
6	2.09-2.35	Mid-infrared	9.23

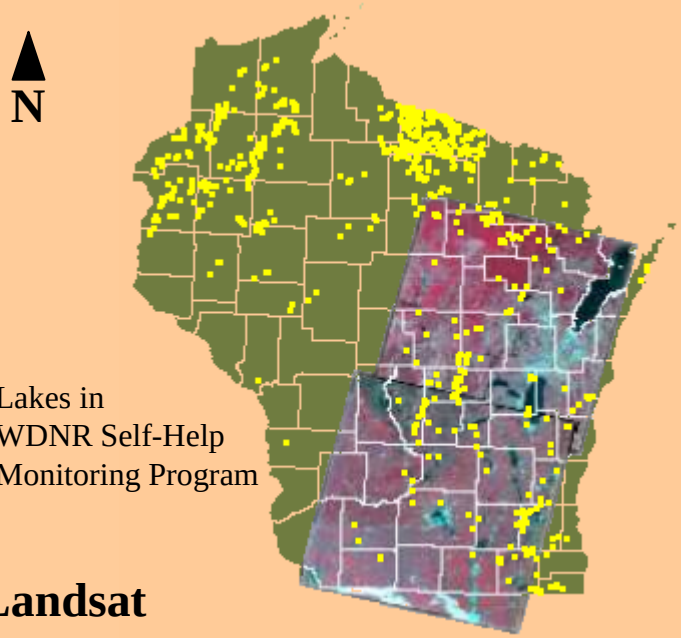
MODEL

Water samples collected by Lake Monitoring Volunteers

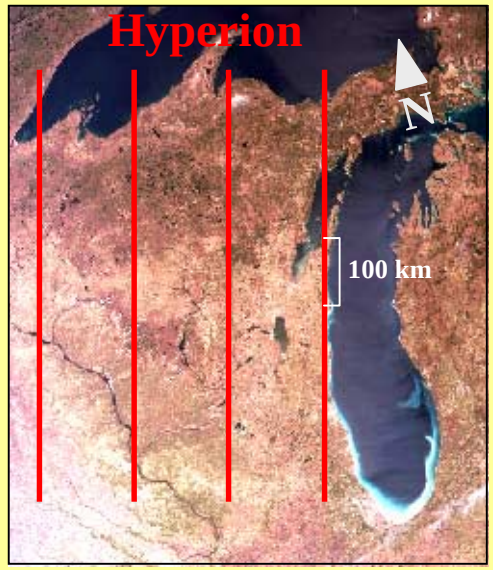
WBIC	Lake Name	Date	SD(feet)
0852400	Lake Keesus	07/26/99	14
0854300	Ashippun L.	07/25/99	7
0816800	Whitewater L.	07/27/99	5
0741500	Pleasant L.	07/28/99	11



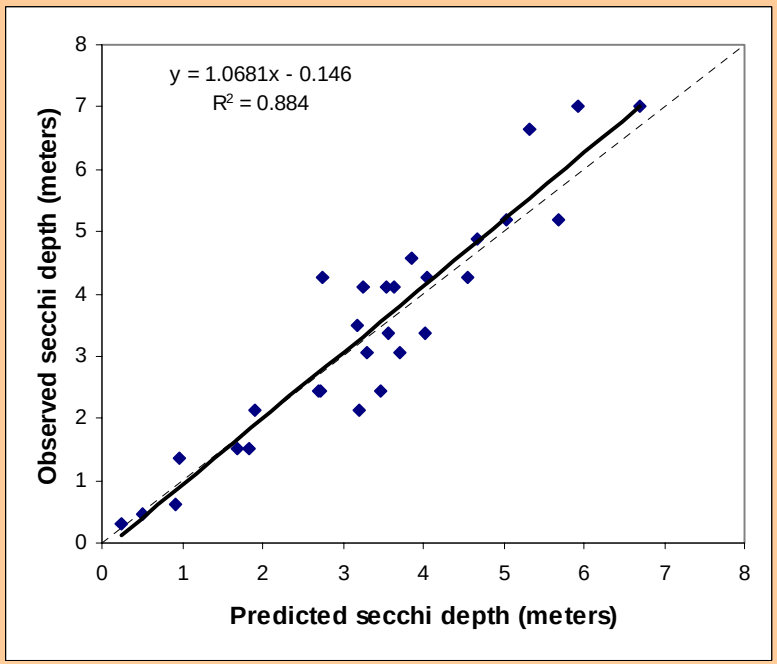
Model output: map of trophic state index (TSI) for all lakes

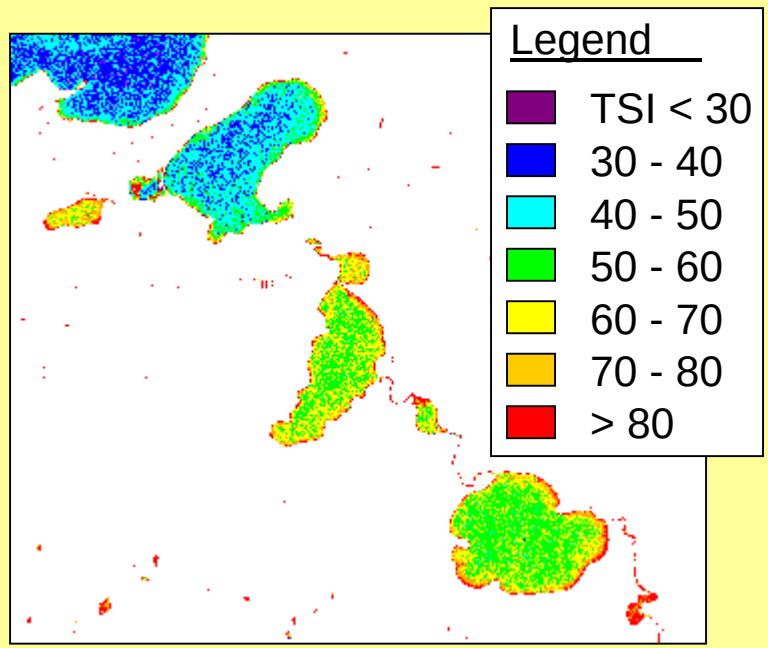


Landsat



MODIS



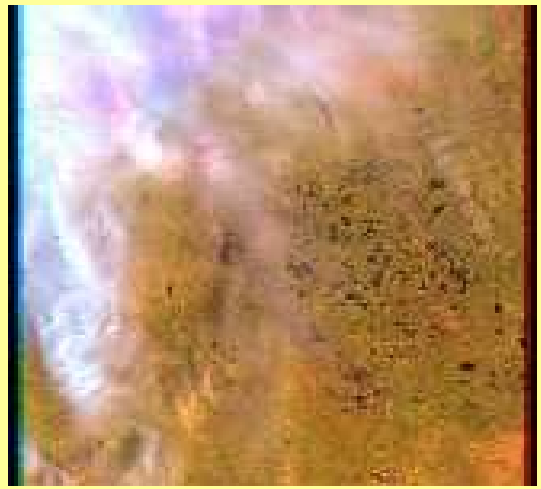


LANDSAT ETM+ Browse Images, Summer 2000

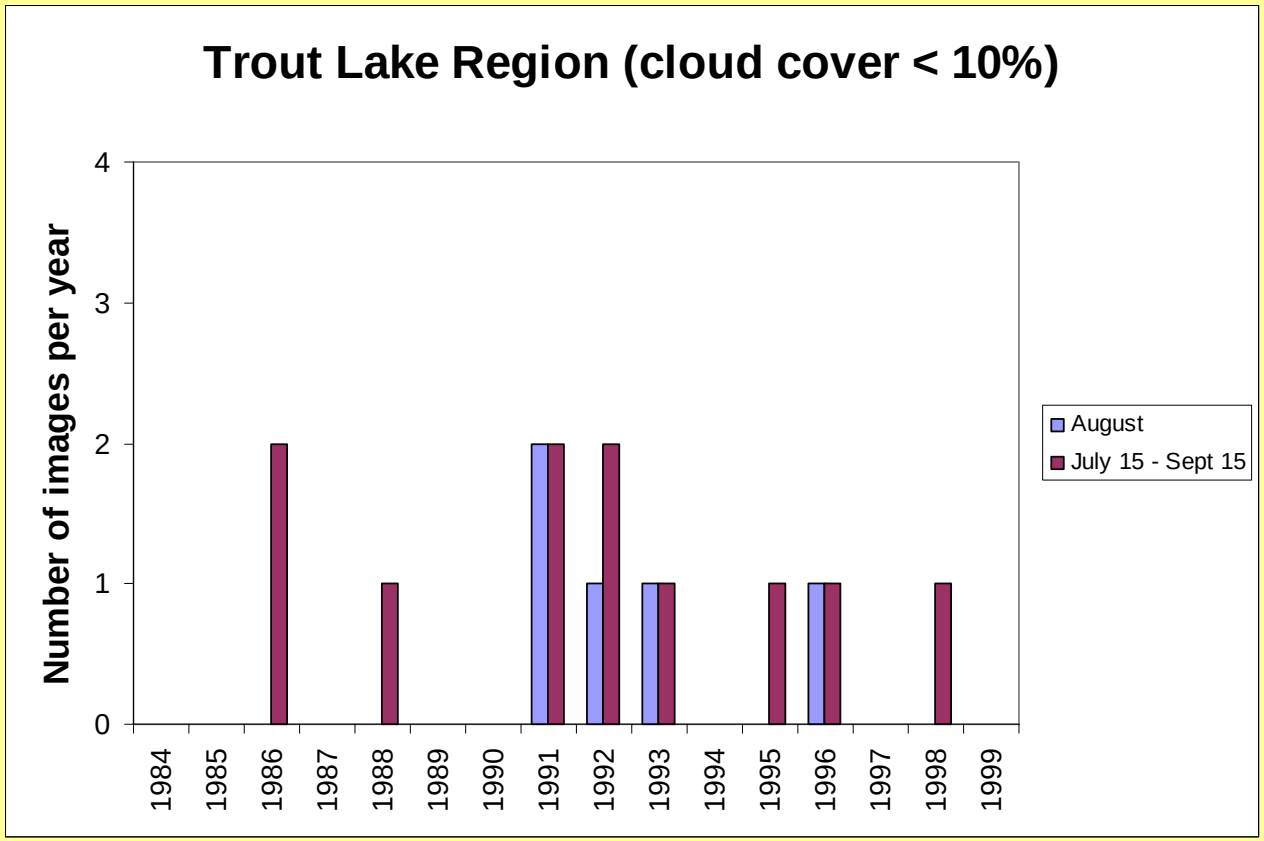
Path 25, Row 28 (North Central Wisconsin)





LANDSAT coverage (I): Trout Lake Region (North Central Wisconsin)



Challenge:

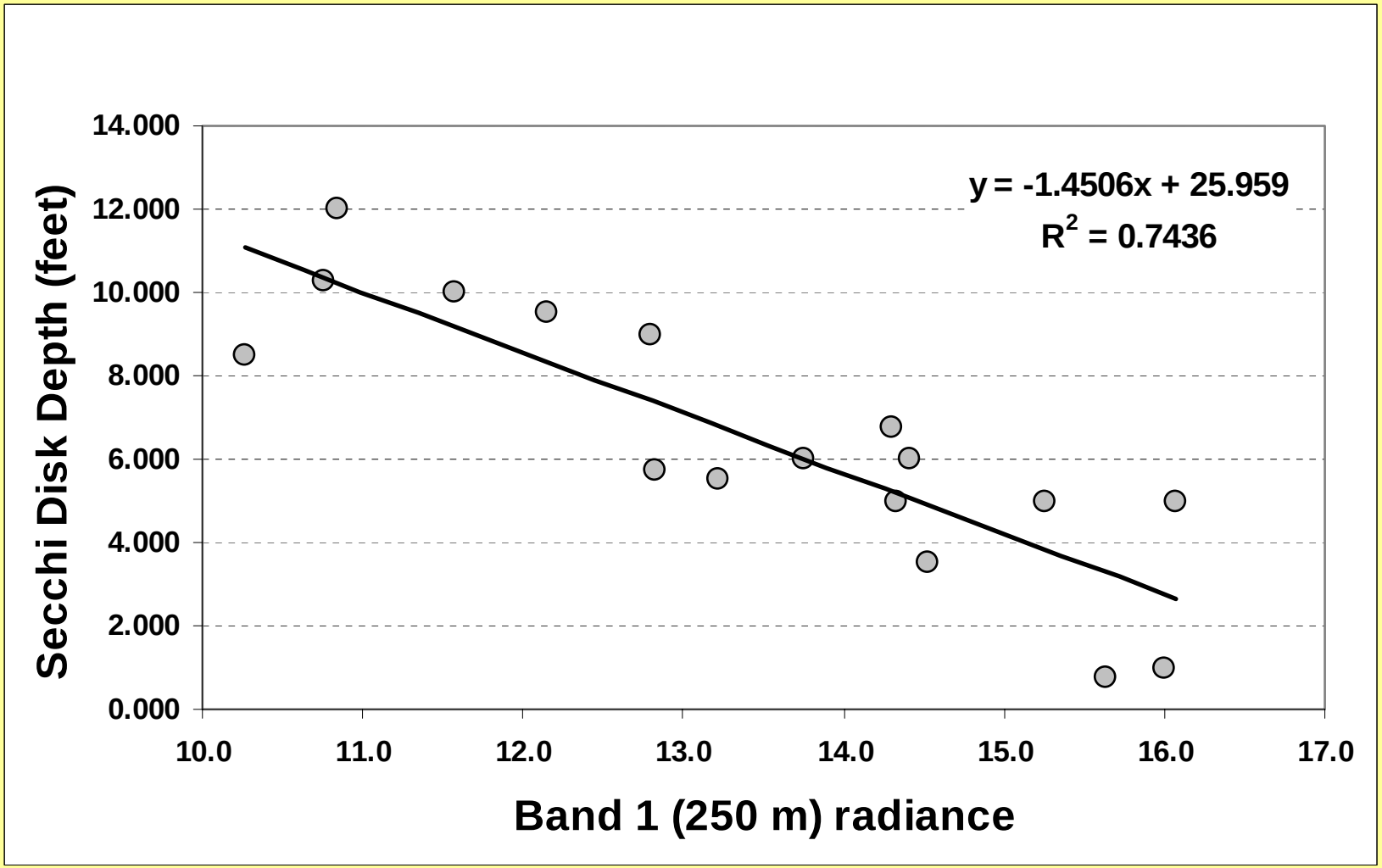
Given Cloud Cover, Is Off-Nadir Viewing Feasible Economically ???

...or, will MODIS save the day??

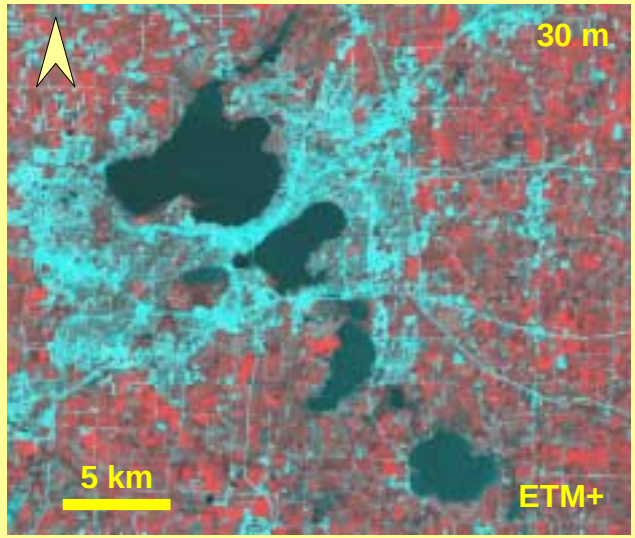
MODIS image of Wisconsin

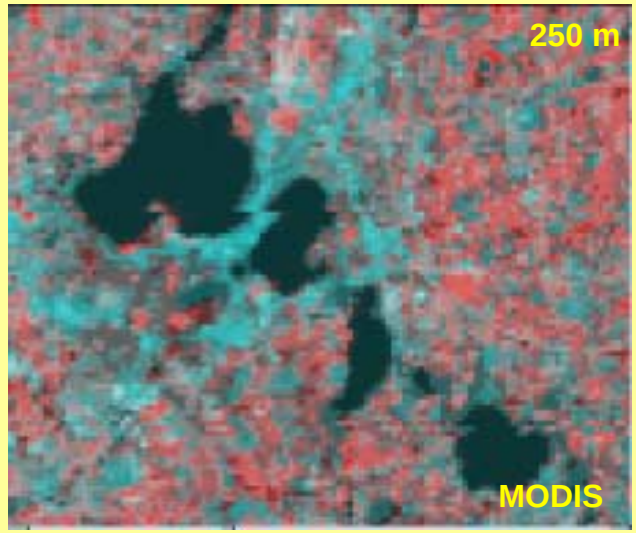
24 April 2000

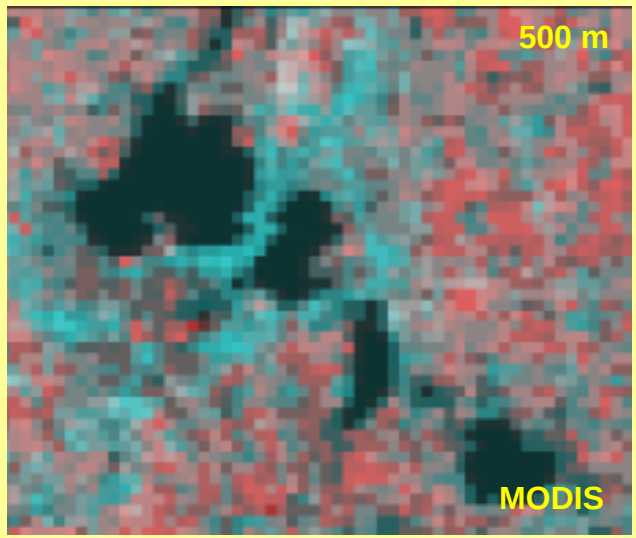
Secchi Disk Depth vs. MODIS Band 1 Radiance

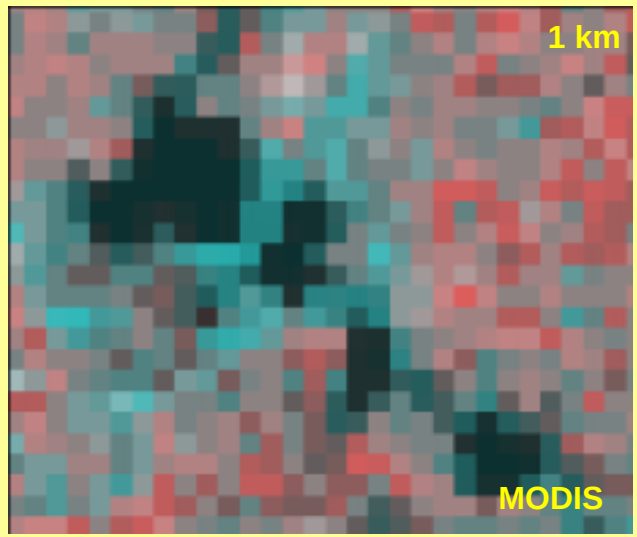


LANDSAT ETM+ vs.
MODIS 250 m, 500 m, and 1 km spatial resolution



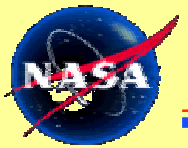






A Reasonable Data Source, but Only for the Larger Lakes

The Commercial Multiplier Effect of Landsat-7 Type Data



The Affiliated Research Center Program

Stennis Space Center

- At UW-Madison, over 150 firms interested to date
- Short-term (6-9 months) assessment
- Applications for a range of private businesses
- Fifteen demonstration projects since 1996, including KL Engineering

Siting and Designing a State Patrol Truck Safety and Weight Enforcement Facility Using Geospatial Information Technologies

ARC Partner:

KL Engineering, Inc.
Madison, Wisconsin

Objectives of a Weigh-in-Motion Facility:

- Improve commercial vehicle safety
- Protect transportation infrastructure
- Facilitate compliance with transportation regulations
- Encourage equitable trucking competition

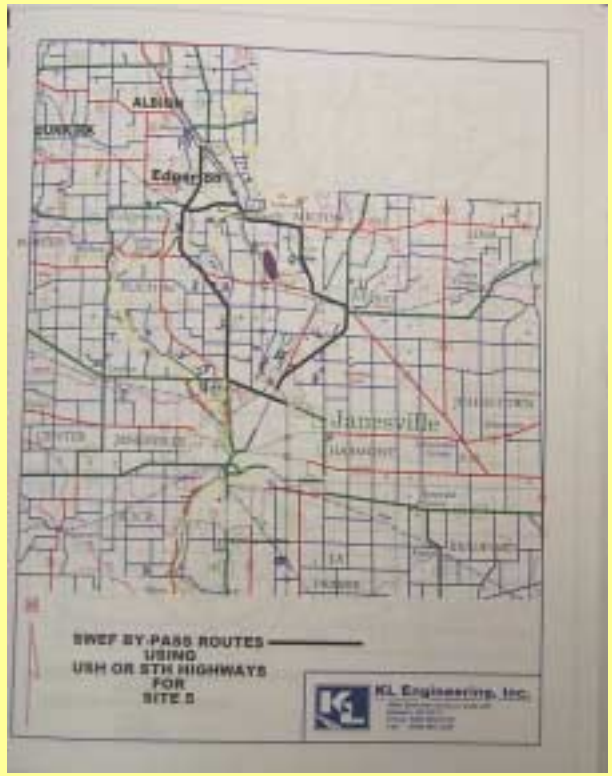
Site Selection Factors:

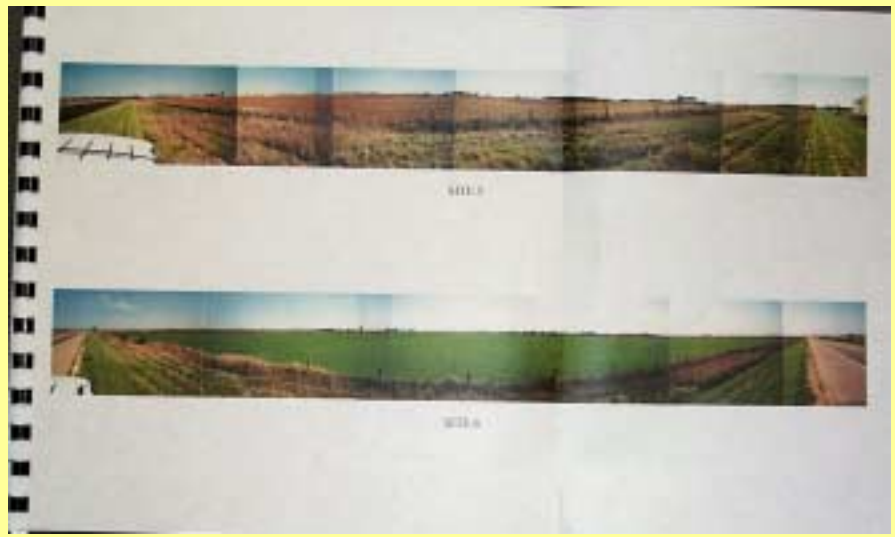
- Mainline Considerations (grades, interchanges, etc)
- Commercial and Residential Development
- Environmental Considerations
- Presence of Gas and Electric Lines
- Others (cost of property, soil type, etc)

Field Evaluation Tools (at present)

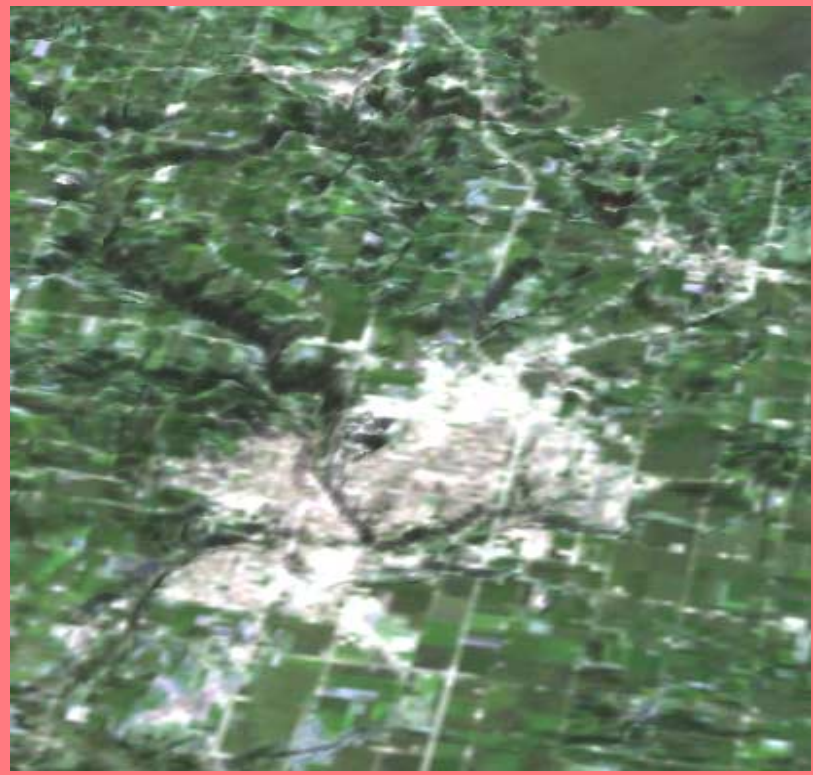

FIELD EVALUATION
OF
NINE SELECTED
SWEF SITE
LOCATIONS

KL Engineering, Inc.





Landsat data



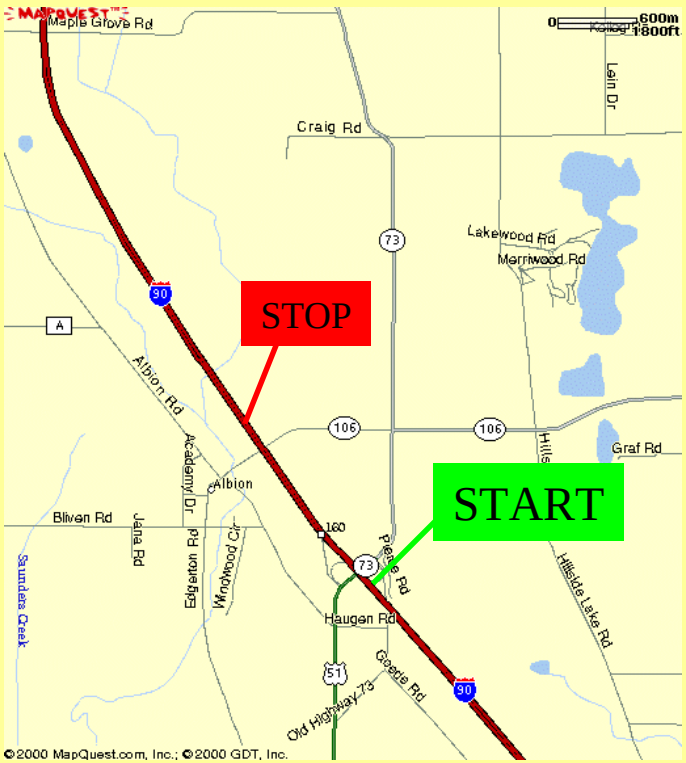
Landsat data with DEM

Corridor visualization options:

- Different Landsat band composites
- 15/30m pan sharpened
- 3-D representations
- Landsat-derived “fly-throughs”

“Finer than Landsat” Fly-throughs

Fly-throughs were created to help visualize the 45+ mile corridor and selected sites. Manipulation of the data and the software offer different perspectives.



Fly-through using 1m data

Annotated 1m image

30 m Landsat 7 ETM+

PhotoLog Front View

PhotoLog Side View

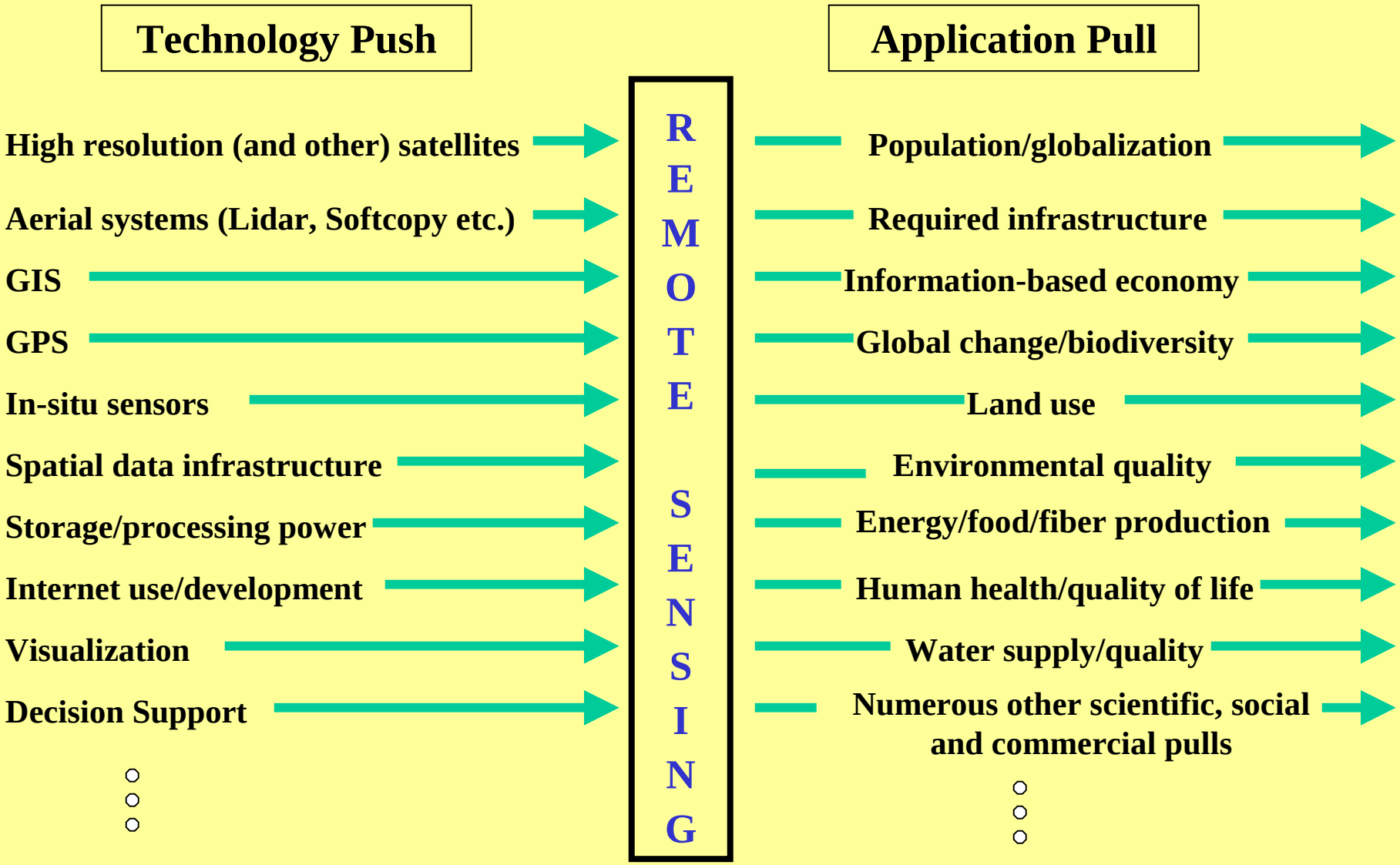
Site “Drive Through”

Landsat 7 ETM+ Application

Single scene Landsat image, 30m multispectral & 15 panchromatic

- Creation of image map options of 45 mile corridor → *Commercial Products* → Use of 1m imagery, orthophotos, & GIS data for further site evaluation
- With 30m USGS DEM, creation of image-based "fly-throughs" → *Commercial Products* → Use of vehicle-based PhotoLog images for site "drive throughs"
- Selected enhancements of 15m panchromatic → *Commercial Products* → Use of high resolution orthophotos and other spatial data for detailed design and construction

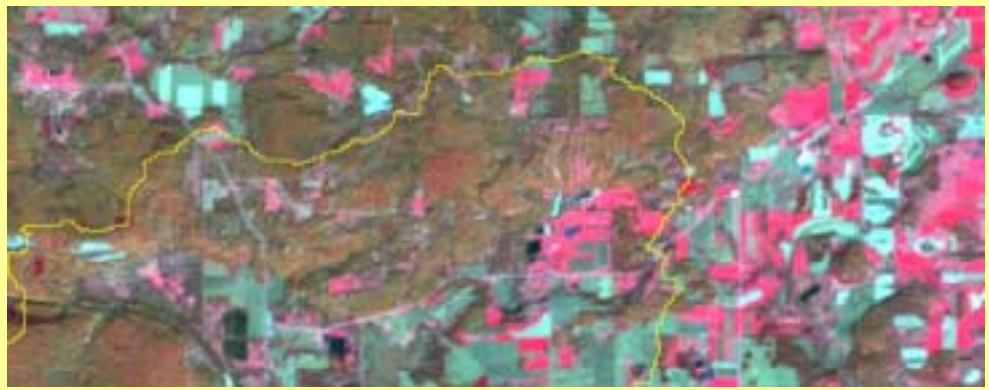
KL Engineering, Inc.
Madison, Wisconsin



The Technology Push and Application Pull of Remote Sensing

Landsat Data

- A Scientific Staple
- A Commercial Multiplier
- A Capital Investment in Scientific, Commercial, and Social Progress



“One of the most significant problems in remote sensing has been the lack of direction for the program.”

Land Remote Sensing Satellite Advisory Committee -- 1983

Testimony on Behalf of ASP(RS) before House Committee on Science and Technology

Subcommittee on Space Science and Applications

and

Subcommittee on Natural Resources, Agricultural Research and Environment

July, 1983

“While I am not familiar with all segments of the user community, those with which I am currently represent a rather fragile market for Landsat data.

The reasons for this are many and varied but they revolve principally around the following:

- The continued uncertainty about the status of the Landsat Program.

- The conduct of the Landsat program fundamentally as an experimental, rather than operational, activity.

- The fundamental shift in the philosophy determining the price structure for Landsat data.

- The lack of aggregation of Landsat users."

“Again, we must consider the

scientific value

of Landsat data along with their

market value

in implementing our present

decision-making process.”

"The real challenge before us is to recognize our remote sensing program as a

public good

and to formulate a policy for the program which will insure future

scientific advances,

assist in the proper

stewardship of our natural resources,

provide

creative commercial opportunities,

and bring remote sensing to a much higher position in our national agenda."